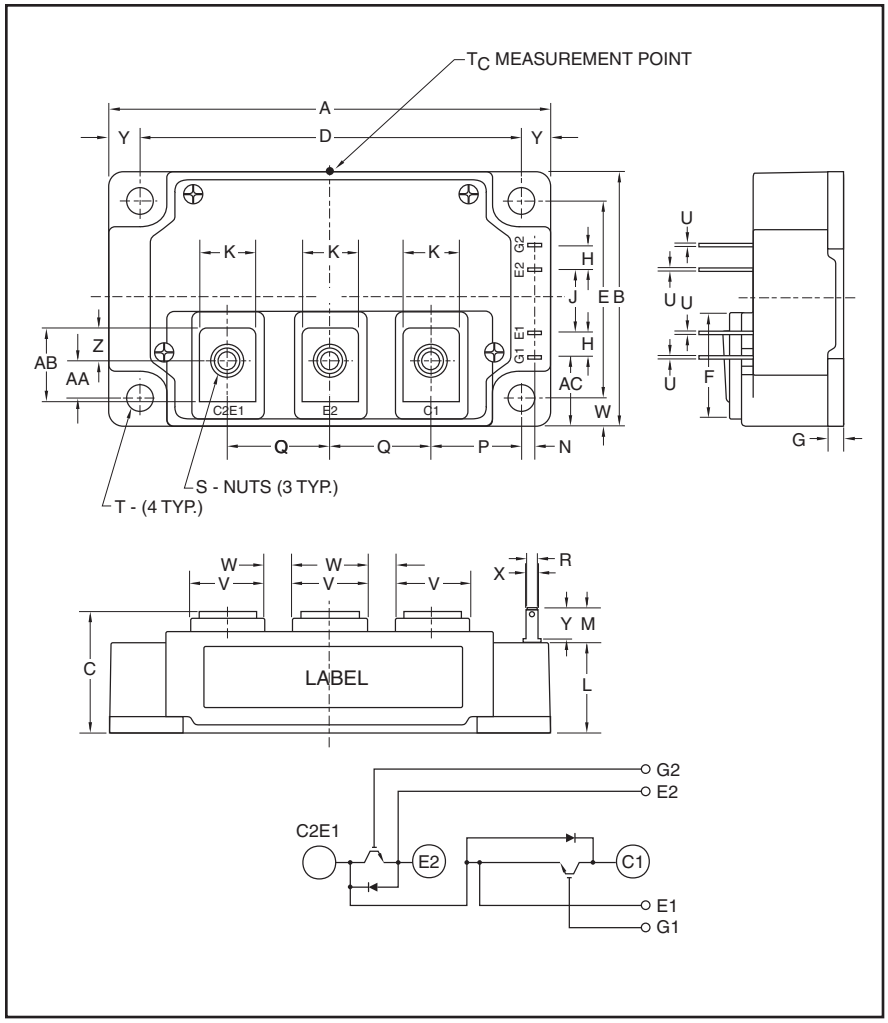
*Powerex, Inc., 173 Pavilion Lane, Youngwood, Pennsylvania 15697 (724) 925-7272*
*www.pwrx.com*

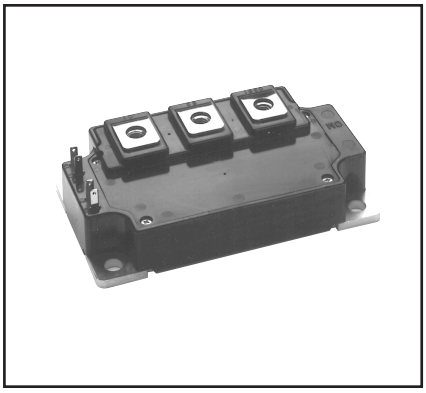
# *Dual IGBT*
## *NFH-Series Module*
### *400 Amperes/600 Volts*




**Outline Drawing and Circuit Diagram**

| Dimensions | Inches | Millimeters |
|---|---|---|
| A | 4.25 | 108.0 |
| B | 2.44 | 62.0 |
| C | 1.14+0.04/-0.02 | 29.0+1.0/-0.5 |
| D | 3.66±0.01 | 93.0±0.25 |
| E | 1.89±0.01 | 48.0±0.25 |
| F | 1.012 | 25.7 |
| G | 0.16 | 4.0 |
| H | 0.24 | 6.0 |
| J | 0.59 | 15.0 |
| K | 0.55 | 14.0 |
| L | 0.87 | 22.0 |
| M | 0.33 | 8.5 |
| N | 0.10 | 2.5 |
| P | 0.85 | 21.5 |

| Dimensions | Inches | Millimeters |
|---|---|---|
| Q | 0.98 | 25.0 |
| R | 0.11 | 2.8 |
| S | M6 Metric | M6 |
| T | 0.26 Dia. | 6.5 Dia. |
| U | 0.002 | 0.5 |
| V | 0.71 | 18.0 |
| W | 0.28 | 7.0 |
| X | 0.16 | 4.0 |
| Y | 0.3 | 7.5 |
| Z | 0.325 | 8.25 |
| AA | 0.35 | 8.85 |
| AB | 0.709 | 18.0 |
| AC | 0.69 | 17.5 |



**Description:**
Powerex IGBT Modules are designed for use in high frequency applications; 30 kHz for hard switching applications and 60 to 70 kHz for soft switching applications. Each module consists of two IGBT Transistors in a half-bridge configuration with each transistor having a reverse-connected super-fast recovery free-wheel diode. All components and interconnects are isolated from the heat sinking baseplate, offering simplified system assembly and thermal management.

**Features:**
- ☐ Low $V_{CE(sat)}$
- ☐ Low $E_{SW(off)}$
- ☐ Discrete Super-Fast Recovery Free-Wheel Diode
- ☐ Isolated Baseplate for Easy Heat Sinking

**Applications:**
- ☐ Power Supplies
- ☐ Induction Heating
- ☐ Welders

**Ordering Information:**
Example: Select the complete part module number you desire from the table below -i.e. CM400DU-12NFH is a 600V ($V_{CES}$), 400 Ampere Dual IGBTMOD™ Power Module.

| Type | Current Rating Amperes | $V_{CES}$ Volts (x 50) |
|---|---|---|
| CM | 400 | 12 |

***CM400DU-12NFH***
***Dual IGBT NFH-Series Module***
*400 Amperes/600 Volts*

## Absolute Maximum Ratings, $T_j$ = 25 °C unless otherwise specified

| Ratings | Symbol | CM400DU-24NF | Units |
|---|---|---|---|
| Collector-Emitter Voltage (G-E Short) | $V_{CES}$ | 600 | Volts |
| Gate-Emitter Voltage (C-E Short) | $V_{GES}$ | ±20 | Volts |
| Collector Current (Operation)*2 | $I_C$ | 400 | Amperes |
| Peak Collector Current (Pulse)*2 | $I_{CM}$ | 800 | Amperes |
| Emitter Current (Operation)*2 | $I_E$*1 | 400 | Amperes |
| Peak Emitter Current (Pulse)*2 | $I_{EM}$*1 | 800 | Amperes |
| Maximum Collector Dissipation ($T_C$ = 25°C) | $P_C$*3 | 960 | Watts |
| Maximum Collector Dissipation ($T_{C'}$ = 25°C)*7 | $P_{C'}$*3 | 1640 | Watts |
| Junction Temperature | $T_j$ | –40 ~ +150 | °C |
| Storage Temperature | $T_{stg}$ | –40 ~ +125 | °C |
| Isolation Voltage (Terminals to Baseplate, f = 60Hz, AC 1 Minute) | $V_{ISO}$ | 2500 | Volts |
| Mounting Torque, M6 Main Terminal | — | 40 | in-lb |
| Mounting Torque, M6 Mounting | — | 40 | in-lb |
| Weight | — | 400 | Grams |

## Electrical Characteristics, $T_j$ = 25 °C unless otherwise specified

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Collector-Cutoff Current | $I_{CES}$ | $V_{CE} = V_{CES}$, $V_{GE}$ = 0V | — | — | 1.0 | mA |
| Gate-Emitter Threshold Voltage | $V_{GE(th)}$ | $I_C$ = 40mA, $V_{CE}$ = 10V | 5 | 6 | 7 | Volts |
| Gate Leakage Current | $I_{GES}$ | $V_{GE} = V_{GES}$, $V_{CE}$ = 0V | — | — | 0.5 | µA |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C$ = 400A, $V_{GE}$ = 15V, $T_j$ = 25°C | — | 2.0 | 2.7 | Volts |
| | | $I_C$ = 400A, $V_{GE}$ = 15V, $T_j$ = 125°C | — | 1.95 | — | Volts |
| Input Capacitance | $C_{ies}$ | $V_{CE}$ = 10V, $V_{GE}$ = 0V | — | — | 110 | nf |
| Output Capacitance | $C_{oes}$ | | — | — | 7.2 | nf |
| Reverse Transfer Capacitance | $C_{res}$ | | — | — | 4.0 | nf |
| Total Gate Charge | $Q_G$ | $V_{CC}$ = 300V, $I_C$ = 400A, $V_{GE}$ = 15V | — | 2480 | — | nC |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{CC}$ = 300V, $I_C$ = 400A, $V_{GE}$ = ±15V, $R_G$ = 3.1Ω, Inductive Load Switching Operation, $I_E$ = 400A | — | — | 400 | ns |
| Turn-on Rise Time | $t_r$ | | — | — | 200 | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | — | — | 700 | ns |
| Turn-off Fall Time | $t_f$ | | — | — | 150 | ns |
| Reverse Recovery Time | $t_{rr}$*1 | | — | — | 200 | ns |
| Reverse Recovery Charge | $Q_{rr}$*1 | | — | 7.7 | — | µC |
| Emitter-Collector Voltage | $V_{EC}$*1 | $I_E$ = 400A, $V_{GE}$ = 0V | — | — | 2.6 | Volts |

*1 Represent ratings and characteristics of the anti-parallel, emitter-to-collector free wheeling diode (FWDi).
*2 Pulse width and repetition rate should be such that device junction temperature ($T_j$) does not exceed $T_{j(max)}$ rating.
*3 Junction temperature ($T_j$) should not increase beyond maximum junction temperature ($T_{j(max)}$) rating.
*7 Case temperature ($T_{C'}$) measured point is just under the chips.

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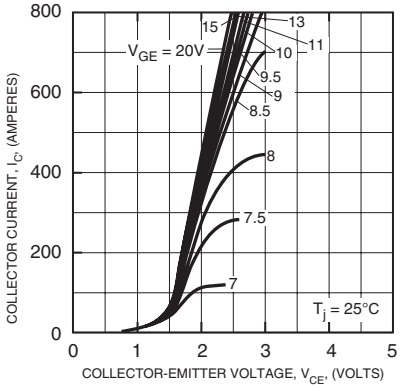
## Thermal and Mechanical Characteristics, $T_j$ = 25 °C unless otherwise specified

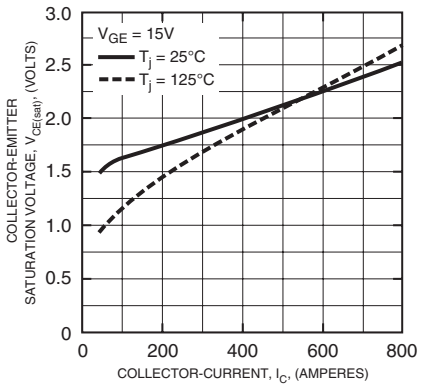
| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Thermal Resistance*4 Junction to Case | $R_{th(j-c)}Q$ | Per IGBT 1/2 Module | — | — | 0.13 | K/W |
| Thermal Resistance*4 Junction to Case | $R_{th(j-c)}D$ | Per FWDi 1/2 Module | — | — | 0.18 | K/W |
| Contact Thermal Resistance*5 Case to Heatsink | $R_{th(c-f)}$ | Per 1/2 Module, Thermal Grease Applied | — | 0.04 | — | K/W |
| Thermal Resistance*7 Junction to Case | $R_{th(j-c)}'Q$ | Per IGBT 1/2 Module | — | — | 0.076*6 | K/W |
| External Gate Resistance | $R_G$ | | 1.6 | — | 16 | Ω |

*4 Case temperature ($T_C$) measured point is shown on page 1 of the outline drawing.
*5 Typical value is measured by using thermally conductive grease of λ = 0.9 [W/(m • K)].
*6 If you use this value, $R_{th(f-a)}$ should be measured just under the chips.
*7 Case temperature ($T_{C'}$) measured point is just under the chips.

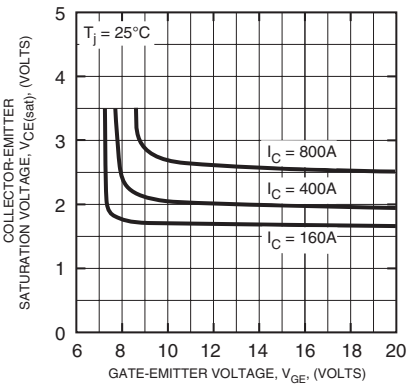
**OUTPUT CHARACTERISTICS (TYPICAL)**



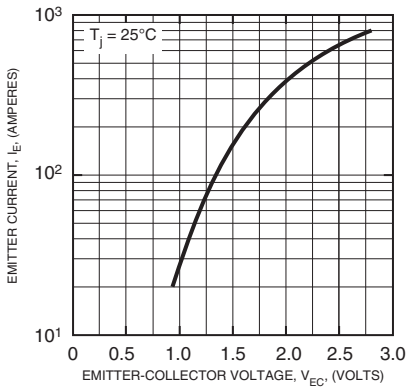

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



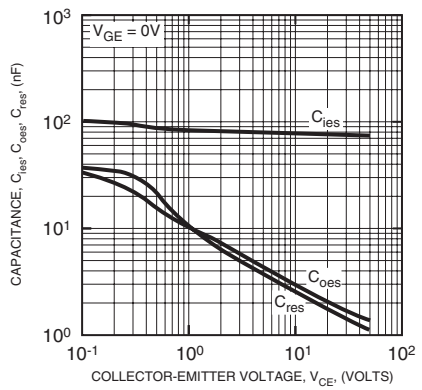

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



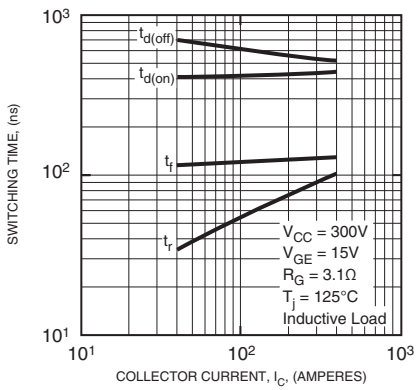

**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**




**CAPACITANCE VS. $V_{CE}$ (TYPICAL)**




**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**



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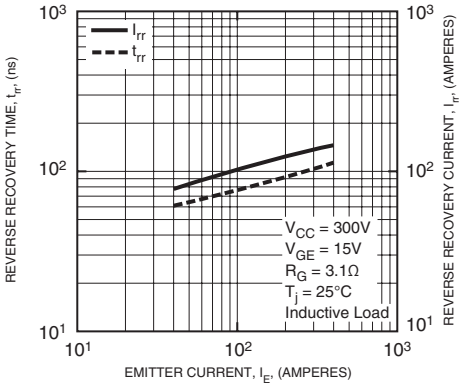
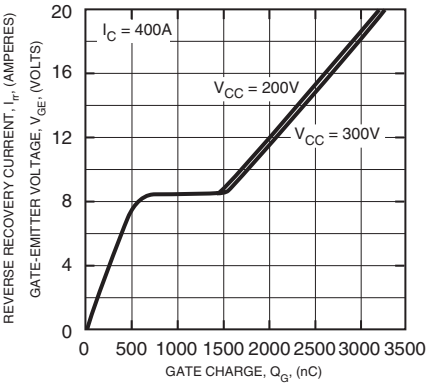
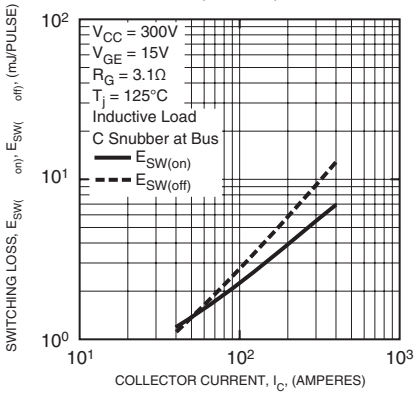
**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



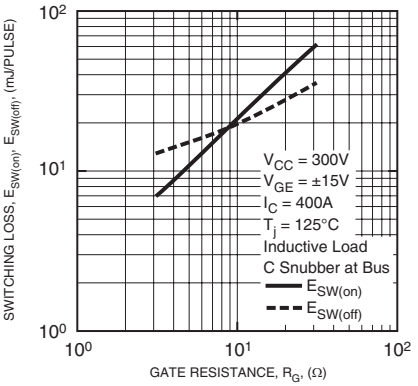

**GATE CHARGE VS. $V_{GE}$**



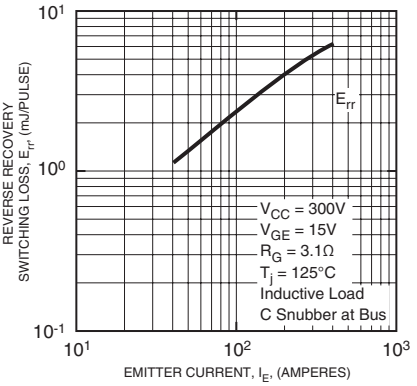

**SWITCHING LOSS VS. COLLECTOR CURRENT (TYPICAL)**



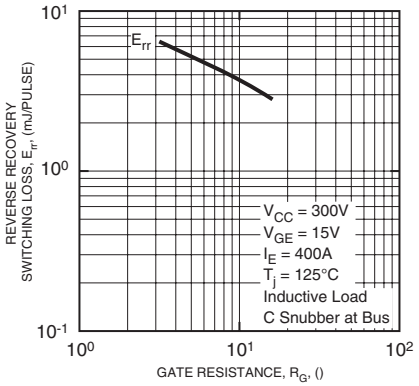

**SWITCHING LOSS VS. GATE RESISTANCE (TYPICAL)**



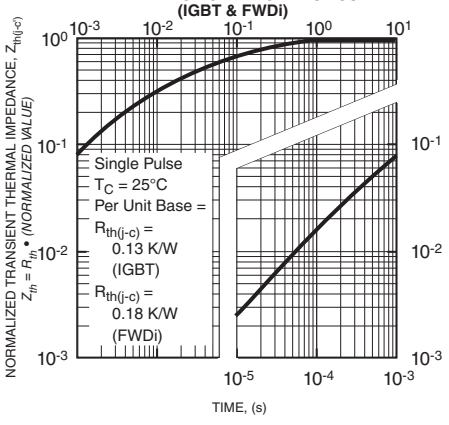

**REVERSE RECOVERY SWITCHING LOSS VS. EMITTER CURRENT (TYPICAL)**




**REVERSE RECOVERY SWITCHING LOSS VS. GATE RESISTANCE (TYPICAL)**




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT & FWDi)**



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